

AMENDMENTS TO THE CLAIMS

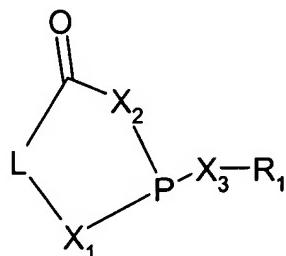
This listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of claims:

1-24 (Canceled)

25. (New) A process for hydrocyanating at a hydrocyanation reaction temperature a hydrocarbon-based compound containing at least one ethylenic unsaturation comprising the step of:

a) reacting said compound in a liquid medium with hydrogen cyanide in the presence of a catalyst comprising a metallic element selected from transition metals and an organophosphorus ligand, wherein the organophosphorus ligand corresponds to general formula (I) below:



wherein:

X₁ and X₂, which are identical or different, represent an oxygen atom or the divalent radical NR₂, wherein R₂ represents a hydrogen atom, an alkyl, aryl, sulphonyl, cycloalkyl or carbonyl radical,

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X₃ represents a covalent bond, an oxygen atom or the divalent radical NR₂, wherein

R₂ represents a hydrogen atom, an alkyl, aryl, sulphonyl, cycloalkyl or carbonyl radical,

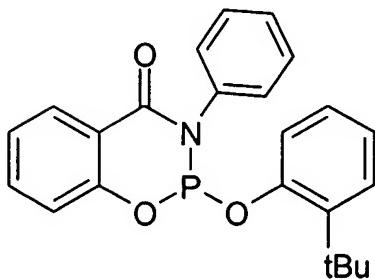
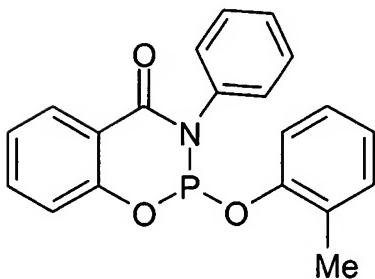
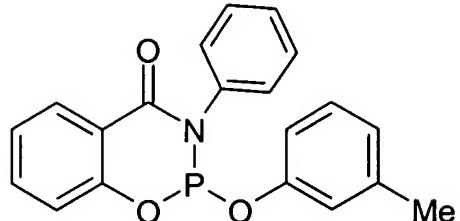
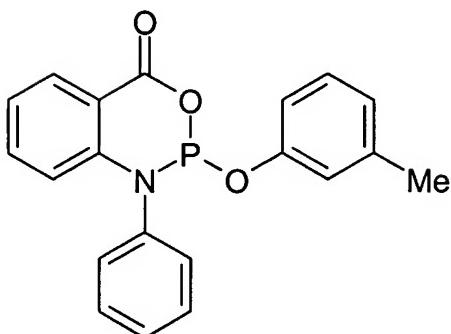
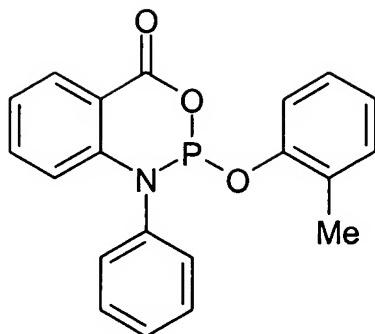
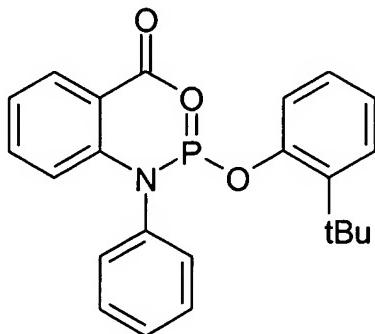
the radical R₁ represents a linear or branched alkyl radical having from 1 to 12 carbon atoms optionally having hetero atoms, or a substituted or unsubstituted aromatic or cycloaliphatic radical optionally having hetero atoms or one or more rings in fused or nonfused form, and

L represents a linear or branched divalent alkyl radical having from 1 to 12 carbon atoms optionally having hetero atoms, or a substituted or unsubstituted aromatic or cycloaliphatic divalent radical optionally having hetero atoms and one or more rings in fused or nonfused form.

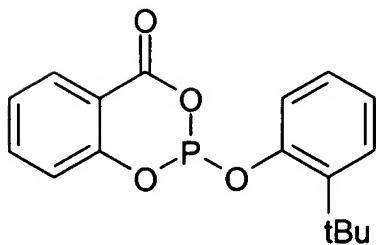
26. (New) The process according to claim 25, wherein X₁ and X₂ are different and represent equally an oxygen atom or a divalent radical NR₂; X₃ represents an oxygen atom; and L represents an aromatic or cyclic divalent radical for which the bonds are in the ortho-position or an alkyl radical for which the bonds are borne by the same carbon.

27. (New) The process according to claim 25, wherein the compounds of general formula (I) are selected from the group consisting of the compounds of formulae below:

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and



28. (New) The process according to claim 25, wherein the metal element is selected from the group consisting of nickel, cobalt, iron, ruthenium, rhodium, palladium, osmium, iridium, platinum, copper, silver, gold, zinc, cadmium and mercury.
29. (New) The process according to claim 25, wherein the reaction is carried out in a single-phase medium.
30. (New) The process according to claim 25, wherein the catalyst corresponds to general formula (V):



wherein:

M is a transition metal,

L_f represents the organophosphorus ligand of formula (I), and

t represents a number between 1 and 6 (limits inclusive).

31. (New) The process according to claim 25, wherein the reaction medium comprises a solvent for the catalyst that is miscible with the phase comprising the compound to be hydrocyanated, at the hydrocyanation temperature.

32. (New) The process according to claim 30, wherein the catalyst is a nickel compound in which nickel is in oxidation state zero, or
a compound of nickel.

33. (New) The process according to claim 32, wherein the catalyst is potassium tetracyanonickelate $K_4[Ni(CN)_4]$, bis(acrylonitrile)nickel zero, bis(cycloocta-1,5-diene)nickel, tetrakis(triphenylphosphine)nickel zero; carboxylate, carbonate,

bicarbonate, borate, bromide, chloride, citrate, thiocyanate, cyanide, formate, hydroxide, hydrophosphite, phosphite, phosphate, iodide, nitrate, sulphate, sulphite, arylsulphonate or alkylsulphonate.

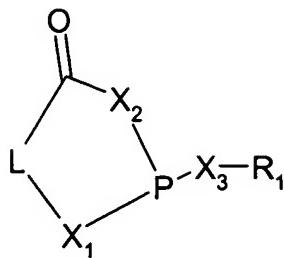
34. (New) The process according claim 25, wherein the organic compound containing at least one ethylenic double bond is a diolefin, ethylenically unsaturated aliphatic nitrile, linear pentenenitrile, monoolefin, or a mixtures thereof.

35. (New) The process according claim 34, wherein the organic compound containing at least one ethylenic double bond is a butadiene, isoprene, hexa-1,5-diene, cycloocta-1,5-diene, 3-pentenenitrile, 4-pentenenitrile, styrene, methylstyrene, vinylnaphthalene, cyclohexene, methylcyclohexene, or mixtures thereof.

36. (New) The process according to claim 25, wherein the catalyst is used in amount such that there is, per mole of organic compound to be hydrocyanated or isomerized, between 10^{-4} and 1 mol of the transition metal, and in that the compound of formula (I) is such that the number of moles of this compound, relative to 1 mol of transition metal, is from 0.5 to 500.

37. (New) The process according to claim 25, wherein the hydrocyanation reaction temperature is between 10°C and 200°C.

38. (New) A process, for hydrocyanating an ethylenically unsaturated nitrile compound to dinitrile, comprising the step of reacting said nitrile with hydrogen cyanide, in the presence of a catalyst system comprising:
at least one transition metal compound,
at least one compound of formula (I) below:



wherein:

X_1 and X_2 , which are identical or different, represent an oxygen atom or the divalent radical NR_2 , wherein R_2 represents a hydrogen atom, an alkyl, aryl, sulphonyl, cycloalkyl or carbonyl radical,

X_3 represents a covalent bond, an oxygen atom or the divalent radical NR_2 , wherein R_2 represents a hydrogen atom, an alkyl, aryl, sulphonyl, cycloalkyl or carbonyl radical,

the radical R_1 represents a linear or branched alkyl radical having from 1 to 12 carbon atoms optionally having hetero atoms, or a substituted or unsubstituted aromatic or cycloaliphatic radical optionally having hetero atoms or one or more rings in fused or nonfused form, and

L represents a linear or branched divalent alkyl radical having from 1 to 12 carbon atoms optionally having hetero atoms, or a substituted or unsubstituted aromatic or cycloaliphatic divalent radical optionally having hetero atoms and one or more rings in fused or nonfused form, and

a cocatalyst consisting of at least one Lewis acid.

39. (New) The process according to claim 38, wherein the ethylenically unsaturated nitrile is a linear pentenenitrile.

40. (New) The process according to claim 38, wherein the linear pentenenitrile contain amounts of other compounds selected from the group consisting of 2-methyl-3-butenenitrile, 2-methyl-2-butenenitrile, 2-pentenenitrile, valeronitrile, adiponitrile, 2-methylglutaronitrile, 2-ethylsuccinonitrile and butadiene.

41. (New) The process according to claim 38, wherein the Lewis acid used as cocatalyst has an element of groups Ib, IIb, IIIa, IIIb, IVa, IVb, Va, Vb, VIb, VIIb or VIII of the Periodic Table of Elements.

42. (New) The process according to claim 38, wherein the Lewis acid is a salt selected from the group consisting of halides, sulphates, sulphonates, haloalkylsulphonates, perhaloalkylsulphonates, haloalkylacetates, perhaloalkylacetates, carboxylates and phosphates. bromide

43. (New) The process according to claim 42, wherein the Lewis acid zinc chloride, zinc bromide, zinc iodide, manganese chloride, manganese bromide, cadmium chloride, cadmium bromide, stannous chloride, stannous bromide, stannous sulphate, stannous tartrate, indium trifluoromethylsulphonate, indium trifluoromethyl acetate, lanthanum chloride, cerium chloride, praseodymium chloride, neodymium chloride, samarium chloride, europium chloride, gadolinium chloride, terbium chloride, dysprosium chloride, hafnium chloride, erbium chloride, thallium chloride, ytterbium chloride, lutetium chloride, lanthanum bromide, cerium bromide, praseodymium bromide, neodymium bromide, samarium bromide, europium bromide,

gadolinium bromide, terbium bromide, dysprosium bromide, hafnium bromide, erbium bromide, thallium bromide, ytterbium bromide, lutetium bromide, cobalt chloride, ferrous chloride or yttrium.

44. (New) The process according to claim 38, wherein the Lewis acid represents from 0.01 to 50 mol per mole of transition metal compound.

45. (New) The process according to claim 38, wherein further comprising the step of carrying out an isomerization reaction of 2-methyl-3-butenenitrile, present in a reaction mixture originating from the hydrocyanation of butadiene, to pentenenitriles, in the absence of hydrogen cyanide, by working in the presence of a catalyst comprising at least one compound of formula (I) and at least one transition metal compound.

46. (New) The process according to claim 45, wherein the 2-methyl-3-butenenitrile subjected to the isomerization is used alone or as a mixture with 2-methyl-2-butenenitrile, 4-pentenenitrile, 3-pentenenitrile, 2-pentenenitrile, butadiene, adiponitrile, 2-methylglutaronitrile, 2-ethylsuccinonitrile or valeronitrile.

47. (New) The process according to claim 45, wherein the isomerization reaction is carried out at a temperature of 10°C to 200°C.

48. (New) The process according to claim 45, wherein the isomerization of the 2-methyl-3-butenenitrile to pentenenitriles is carried out in the presence of at least one transition metal compound and of at least one organophosphorus compound of formula (I).